INSTRUCTION MANUAL

VARI-MARKER F

KAY ELECTRIC CO.
PINE BROOK, N. J.

June, 1961

Instruction Manual

for

VARI-MARKER MODEL F

KAY ELECTRIC COMPANY

Pine Brook, N. J. CApital 6-4000

Copyright, Kay Electric Co., 1961

POLICY COVERING REPRODUCTION
AND USE OF TECHNICAL DATA

KAY ELECTRIC COMPANY

DATA CONTAINED IN THIS MANUAL IS COPYRIGHTED BY KAY ELECTRIC COMPANY AND IS FURNISHED SOLELY FOR THE PURPOSE OF PROVIDING INSTRUCTIONS FOR OPERATION AND MAINTENANCE OF THE APPARATUS DESCRIBED HEREIN. SAID DATA SHALL NOT BE USED BY THE PURCHASER OR THE GOVERNMENT FOR PROMOTIONAL PROCUREMENT, DEVELOPMENT, OR MANUFACTURING PURPOSES, NOR SHALL THE DATA BE DISCLOSED WITHOUT PERMISSION FROM KAY ELECTRIC COMPANY. IN THE EVENT OF RESALE OF THE APPARATUS TO THE GOVERNMENT BY THE PURCHASER, THE PURCHASER SHALL NOTIFY THE GOVERNMENT OF THE LIMITED RIGHT TO USE SAID DATA.

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_05633

TABLE OF CONTENTS

Paragraph		Page
	SECTION I, FUNCTION AND DESCRIPTION	
1-1	Introduction	1
1-2	Specifications	1
1-3	Tube and Diode Complement	2
1-4	Equipment Supplied	2
	SECTION II, INSTALLATION	
2-1	General Instructions	3
2-2	Equipment Interconnections	3
2-3	Front-of-Panel Controls	5
2-4	Front-of-Panel Terminals	6
2-5	Internal Controls	6
	SECTION III, OPERATION	
3-1	Operation	7
	SECTION IV, CIRCUIT DESCRIPTION	
4-1	Introduction	8
4-2	Overall Circuit Analysis	8
	SECTION V, MAINTENANCE	
5-1	Introduction	11
5-2	Check-Out of Circuit Alignment	11
5-3	Reshipment Instructions	14
	SECTION VI, LISTING OF REPLACEABLE PARTS	
6-1	Introduction	16
6-2	Vari-Marker Model F Parts List	16

LIST OF ILLUSTRATIONS

Fig. 2-1	Equipment Interconnections	4
Fig. 4-1	Block Diagram, Vari-Marker Model F	9
Fig. 5-1	Equipment Interconnections for Alignment Checks	12
Fig. 5-2	Detector Probe	13
Fig. 6-1	Schematic KD-6986-C, Vari-Marker Model F	20

SECTION I
FUNCTION AND DESCRIPTION

1-1 INTRODUCTION.

The Vari-Marker Model F is intended for use with the Ligna-Sweep Model SKV sweeping oscillator. The sweeping r-f output from the SKV is used by the Vari-Marker to generate 18 crystal-controlled, pulse-type frequency markers which are selectable in 6 groups of 3 markers each. Marker amplitude is adjustable. A built-in precision step-attenuator permits precise attenuation of the swept RF ahead of the input to the circuit or device under test. The built-in, regulated power supply furnishes all power for the Vari-Marker.

1-2 SPECIFICATIONS.

MARKERS- 18 crystal-controlled, pulse-type frequency markers available in 6 groups of 3 markers per group.

GROUP 1	GROUP 2	GROUP 3
135.0 mc	20.25 mc	3.10 mc
136.5 mc	20.75 mc	3.25 mc
138.0 mc	21.25 mc	3.40 mc

GROUP 4	GROUP 5	GROUP 6
3.20 mc	440 kc	450 kc
3.25 mc	455 kc	455 kc
3.30 mc	470 kc	460 kc

MARKER ACCURACY- $\pm$0.05%

MARKER AMPLITUDE- Positive pulse, variable to 10-V peak.

ATTENUATOR- Individual switched steps of 0.5 db, 1 db, 2 db, 20 db and 20 db, all additive. Output impedance 50 ohms.

POWER SUPPLY- Input approx. 70 watts, 117-V, 60 cps.
B+ electronically regulated.

1-3 TUBE AND DIODE COMPLEMENT.

VACUUM TUBES

TYPE	QUANTITY
12AT7	2
6AH6	1
E 280 F	1
12BH7	1
5963	1
5Y3	1
6AQ5	2
5651	1
6AG5	1
OB2	1
12AU7	1

DIODES

TYPE	QUANTITY
1N126A	5
G7C	6

1-4 EQUIPMENT SUPPLIED.

a. Vari-Marker Model F complete with power supply, mounted in metal cabinet for bench-top operation, or less cabinet for mounting in standard 19-inch relay rack.

b. Marker crystals as specified.

c. Operation and Maintenance Manual

SECTION II
INSTALLATION

2-1 GENERAL INSTRUCTIONS.

As soon as the Vari-Marker is received, it should be visually inspected to determine that the instrument was not damaged during shipment. A careful check of packing case contents should also be made to insure removal of all items shipped. Shortage or damage, should be reported immediately to the carrier and Kay Electric Company, or its representative in your area.

Installation of the Vari-Marker Model F presents no particular problem since the instrument is self-contained, including the power supply and is designed for either bench-top operation or for mounting in a standard 19-inch relay rack. It is recommended that sufficient space be allotted to avoid obstruction of the ventilating louvers. Space should be provided for the Ligna-Sweep Model SKV sweeping oscillator and the cathode-ray oscillograph.

The operating area selected should be as free as possible from vibration, due to the presence of operating machinery, or other sources of vibration. Extreme variations of ambient temperature should also be avoided. Observation of these precautions will result in the user realizing optimum performance of the equipment.

2-2 EQUIPMENT INTERCONNECTIONS.

Interconnections between the Vari-Marker, the scope and the circuit to be tested will be determined, at least partially, by the requirements of the circuit under test. Figure 2-1 illustrates the basic inter-equipment connections. The use of coaxial cable is recommended where indicated, to avoid pick-up of spurious signals. All leads should be kept to minimum length consistant with placement of equipment on the bench or in the rack. The use of appropriate coaxial connectors at the cable ends will assure a good common ground between equipment and proper shielding at the terminations.

STEP 1 - Connect a coaxial cable between the SWEEP OUT terminals on the SKV and the horizontal input terminals on the scope.

STEP 2 - Connect a coaxial cable between the RF OUT terminal on the SKV and the RF IN terminal on the Vari-Marker. Provide another coaxial patch cord between the RF OUT terminal on the Vari-Marker and the INPUT of the circuit under test. If the input impedance of the tested circuit differs substantially from the 50-ohm output impedance of the Vari-Marker, a suitable impedance matching pad should be inserted between these terminals.

STEP 3 - Connect a suitable coaxial patch cord between the MARKER RF OUT terminal on the SKV and the MARKER RF IN terminal on the Vari-Marker. Provide a similar connection between the DET IN terminal on the SKV and the OUTPUT of the tested circuit.

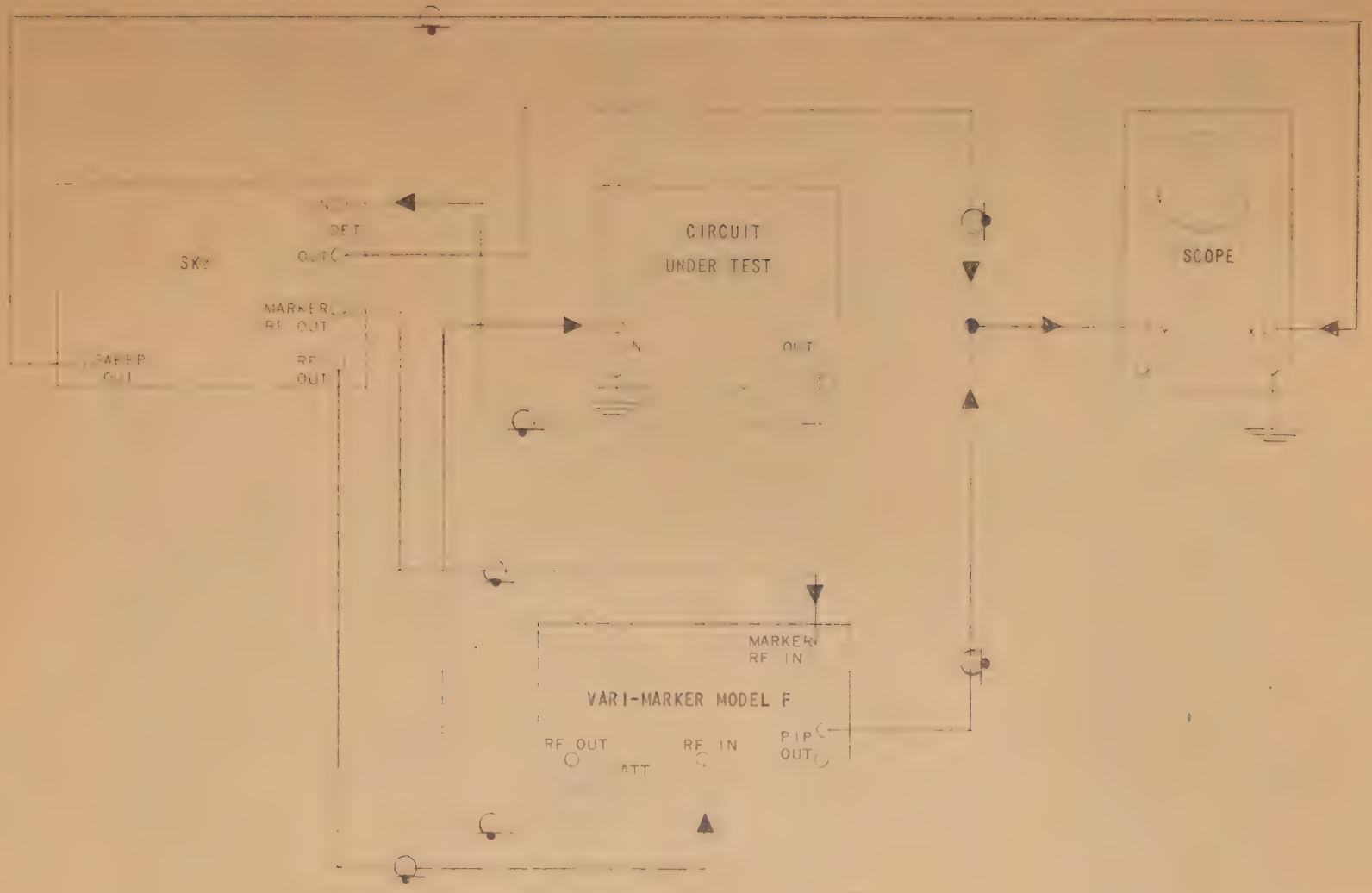


Fig. 2-1, Equipment Interconnections

STEP 4 - Now provide a coaxial cable patch between the DET OUT terminal on the SKV and the vertical input on the scope. The last connection to be provided in the typical set-up shown in Fig. 2-1 is between the PIP OUT terminal on the Vari-Marker and the vertical input of the scope. The terminating connectors used at the vertical input of the scope will depend on the type of input terminals used on the scope. If universal-type binding posts are used, G-R type shielded adaptors can be used on the patch cables; if BNC-type coaxial terminals are used, a T-connector can be used and the patch cords terminated with compatible coaxial connectors.

2-3 FRONT-OF-PANEL CONTROLS.

CONTROL	POSITION	FUNCTION
Power ON-OFF Switch S-1	ON	In the ON position, a-c power is applied to power transformer T-4 energizing the circuits. Panel lamp indicates the application of a-c power to the instrument.
	OFF	In the OFF position, the instrument is completely de-energized.
MARKER SELECTOR Switch S-2	OFF	In the OFF position, no marker signals appear at the PIP OUT terminal J-2. However, the swept RF from the SKV (RF OUT) is passed through the attenuator in the Model F to the device under test permitting alignment operations which do not require markers.
	Positions 1 thru 6	For each of these positions, 3 frequency markers are developed at the frequencies shown in the Specifications, Section 1-2, page 1.
	Positions 7 and 8	These positions of S-2 are reserved as spares.
PIP ADJ Pot R-35	Variable	This control is used to establish the firing point of the Schmitt Trigger (V-5). The proper setting for this control is a point midway between the setting at which one or more marker pips disappear and the setting at which multiple or spurious pips appear. This control also acts as a vernier for the internal PIP ADJ pot R-34.

CONTROL	POSITION	FUNCTION
PIP LEVEL pot R-44	Variable	The amplitude of the marker pips appearing on the scope screen can be varied to 10 volts peak, according to the setting of this control.
Attenuator Switches S-3 thru S-7	Stepped	These toggle switches permit insertion of additive, stepped attenuation of 0.5 db, 1 db, 2 db, 20 db and 20 db between the RF OUT terminal on the SKV and the input to the device under test. Fig. 2-1.

2-4 FRONT-OF-PANEL TERMINALS.

TERMINAL	FUNCTION
MARKER RF IN Jack J-1	This is a BNC-type terminal to which the MARKER RF OUT signal from the SKV is applied.
RF IN Jack J-3	This is the input terminal to the step-attenuator.
RF OUT Jack J-4	This is the output terminal of the step-attenuator.
PIP OUT Jack J-2	This is a BNC-type binding post at which fixed, crystal-controlled frequency identifying pulses are available.

2-5 INTERNAL CONTROLS.

CONTROL	POSITION	FUNCTION
PIP ADJ Pot R-34	Variable	This control, located on the right side of the chassis, is used to establish the range of the front-of-panel PIP ADJ control R-35.
PIP GEN ADJ Pot R-42	Variable	This control is also located on the right side of the chassis, and is used to establish the point at which the pip generator (V-6) fires.
VOLT. REG. Pot R-83	Variable	This control is located at the rear of the chassis and is used to adjust the B+ output to 250 volts (as measured between the junction of C-37B, R-85 and chassis ground).

NOTE: Adjustment of variable components other than those above should not be made except when realignment of the instrument is contemplated.

SECTION III
OPERATION

3-1 OPERATION.

It is assumed the Vari-Marker and associated equipment have been interconnected as shown in Fig. 2-1 and outlined in Section 2-2. A warm-up period of approximately fifteen minutes should be allowed to stabilize the circuits. The operator should become familiar with the operating controls of the Vari-Marker which are listed and described in Section 2-3. The function of operating controls for the Ligna-Sweep SKV are fully described in the separate manual for that instrument.

It is important that the marker spread and sweep width be compatible. As a general rule-of-thumb, sweep width should be two to three times that of the marker spread for proper frequency indication on the response curve developed on the CRO screen. For example, the markers of Group 1 (see Specifications, Section 1-2) will be clearly displayed if the sweep width is between 6 and 9 mc wide. The markers of Group 6 will clearly indicate frequency if the sweep width is between 20 and 30 kc wide. These examples are based on the assumption that linear sweeps from the SKV are being used. The step-attenuator, located between the RF IN and RF OUT terminals on the Vari-Marker, may be used to attenuate the sweeping rf applied to the circuit under test for precise quantitative measurements.

The PIP ADJ control on the Vari-Marker should be adjusted until a single, stable marker appears on the trace for each of the three frequency markers for the group in use. Marker amplitude can be adjusted with the PIP LEVEL control.

SECTION IV
CIRCUIT DESCRIPTION

4-1 INTRODUCTION.

This section is devoted to a general discussion of the Vari-Marker circuits. While this information is not essential to operate the instrument, it is of value to the service technician and others desiring knowledge of the several circuits. It is suggested that the schematic (KD-6986-C) and the Block Diagram shown in Fig. 4-1 be referred to during this discussion.

4-2 OVERALL CIRCUIT ANALYSIS.

The frequency markers in Groups 1 through 4 (see Specifications, Section 1-2) are developed as the sweeping rf (obtained from J-2 in the SKV and applied to J-1 in the Vari-Marker) passes the resonant frequency of the marker crystals in the circuit. Fig. 4-1. For these marker groups, the 1-mc crystal oscillator (V-1), balanced modulator (Mixer) and buffer amplifier (V-2) are not functioning.

Markers for Groups 5 and 6 are developed from the sum frequencies generated in the balanced modulator from the mixing of the swept rf and output from the 1-mc crystal oscillator, V-1. Buffer amplifier V-2 provides the additional amplification to drive the marker crystals, and also serves to isolate the crystals from the difference frequencies developed in the mixer.

All crystals in the crystal marker circuits are specifically cut to the customer's order. Trimmer capacitors, inductors, resistors, etc., in this circuit are also selected at the plant to furnish frequency markers for each group at specified frequencies; therefore, electrical values have not been assigned to components in this circuit. It should also be pointed out that this circuit (as shown on the schematic) illustrates the basic concept and may be modified by insertion of inductors, additional capacitors, resistors, etc., to produce frequency markers as specified by the customer.

The marker pulses developed as the sweeping rf resonates the marker crystals at their characteristic frequency, are detected by the diode in the circuit (D-6, D-7, etc.), producing damped oscillations which are coupled out through S-2C to the 2-stage Trigger Amplifier V-4. The diode (D-5) in the grid circuit of V-4B clips the negative portion of the amplified damped oscillation to present a negative pulse at the input grid of Schmitt Trigger V-5. A trigger is produced at plate B of V-5 for each pulse produced by a resonating crystal. Potentiometers R-34 and R-35 are used to establish the firing point of the Schmitt Trigger.

The Pip Generator (V-6) employs a type 12AT7 tube in a one-shot multivibrator circuit. Section B of V-6 is normally biased to cut-off, due to the direct coupling between plate #1 and section B grid. The grid in section A is essentially at ground during the quiescent state.

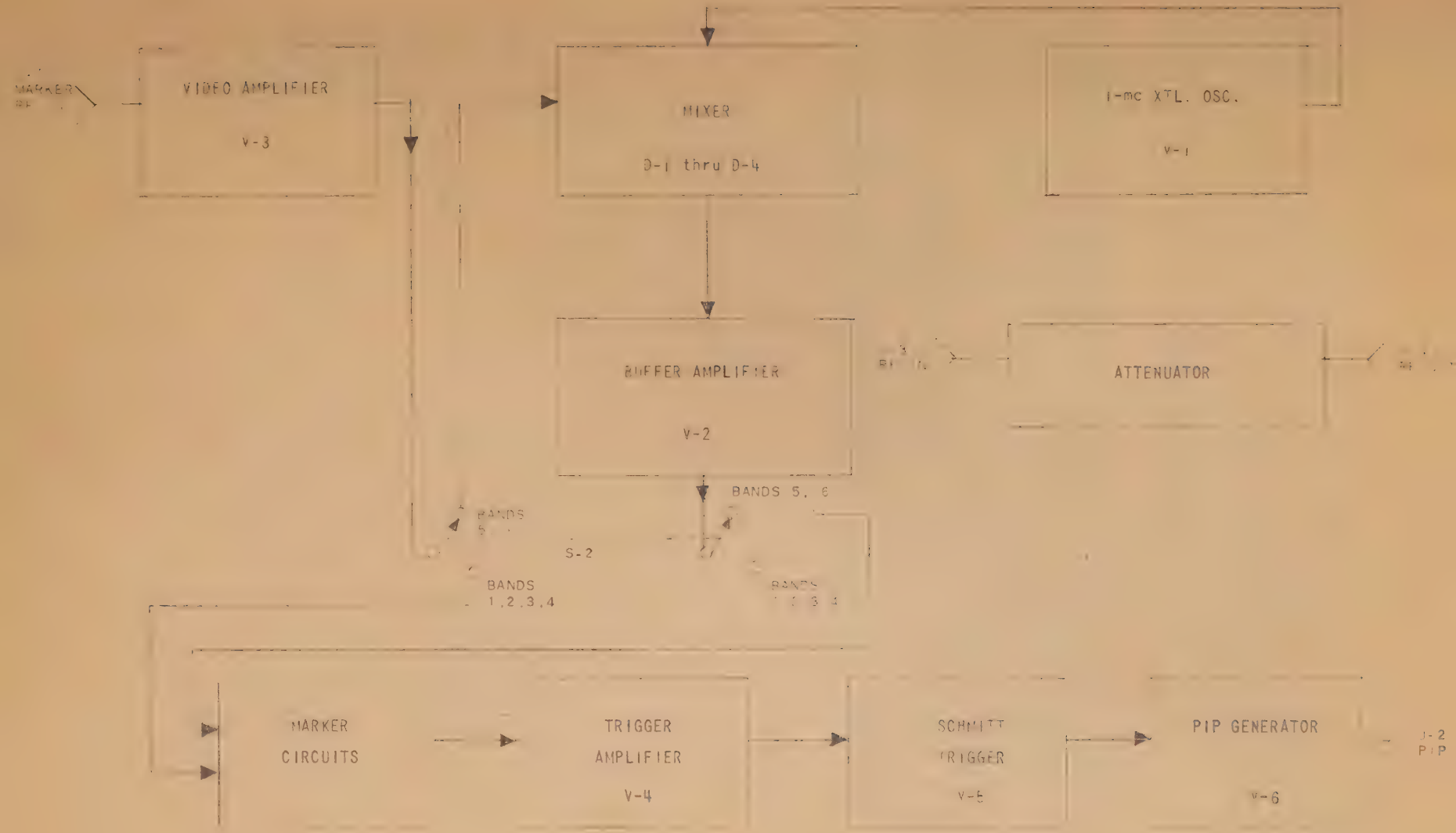


Fig. 4-1. Block Diagram, Vari-Marker Model F

The incoming negative trigger from V-5 decreases the current through section A, causing a rise in plate voltage at plate A. Since there is a direct connection between plate A and grid B, bias in this section is reduced permitting conduction through section B, after which the circuit immediately returns to its original state and awaits the next trigger, the complete cycle occuring very rapidly. Internal PIP ADJ pot R-42 determines the firing point of V-6 by establishing the cathode bias which is obtained from B+ through R-40 and R-41. The PIP LEVEL control R-44 permits adjustment of pip amplitude at the PIP OUT jack J-2.

Regulated B+ and filament voltage for the r-f circuits is developed in the built-in, electronically-regulated power supply. The output from full-wave rectifier V-7 is filtered by L-9, C-37 and C-38 and passed to the voltage regulation circuits in which V-8, V-9 are effectively in series with the B+ output. Power-line fluctuations or changes in power-supply load are reflected as voltage variations at the cathode resistors R-77, R-82. These variations are passed through V-12 to V-11 where they are amplified. Since there is a direct connection between the plate of V-11 and the grids of V-10, the control tube, voltage variations corresponding to the power-line fluctuations or power-supply load changes will be developed across cathode resistor R-74. The grids of V-8, V-9 obtain their bias potential from the cathode of V-10, therefore, voltage variations here will cause V-8, V-9 to conduct more or less current. The voltage developed at the cathode resistors R-77, R-82 is the B+ voltage. Circuit parameters are such that the B+ is held constant.

SECTION V
MAINTENANCE

5-1 INTRODUCTION.

This section contains instructions for adjustment of the variable components, check-out of individual circuits, and complete alignment of the circuitry.

Normal aging of components and tubes, plus prolonged operation of the instrument, may effect performance. Should it become necessary to realign the instrument, it is recommended the following sequential procedures be adhered to. The accuracy of alignment will depend on the accuracy of the signal sources used and precision of adjustments made during the alignment and adjustment procedure. Equipment required includes:

1. Cathode-ray oscillograph and detector probe.
2. VTVM
3. Signal generator, 400 kc to 138 mc.
4. Electronic counter.
5. Ligna-Sweep SKV

5-2 CHECK-OUT OF CIRCUIT ALIGNMENT.

Interconnect the Vari-Marker, Ligna-Sweep SKV and scope as shown in Fig. 5-1 and allow a 15-minute warm-up period to stabilize the circuits. During this time check the B+ voltage, which should be 250 volts, as measured with a VTVM between the junction of C-37B,R-85 and chassis ground. Adjust R-83 if necessary to obtain this voltage.

STEP 1 - CHECK VIDEO AMPLIFIER (V-3).

Set the Band Selector on the SKV for a sweeping output centered around 135 mc. Connect the detector probe to the switch side of C-17. Adjust the slug in L-3 for maximum deflection of scope trace.

STEP 2 - CHECK CRYSTAL OSCILLATOR (V-1).

Connect the VTVM through a 39-K resistor to pin 2 of V-1 (VTVM set for negative voltage). Adjust the slug in T-1 for a peak reading on the VTVM. Disconnect the VTVM. Connect the counter to pin 6 of V-1, using a 5uuf capacitor in series with the counter lead. Output frequency should be 1 mc ±0.005%. Disconnect the counter.

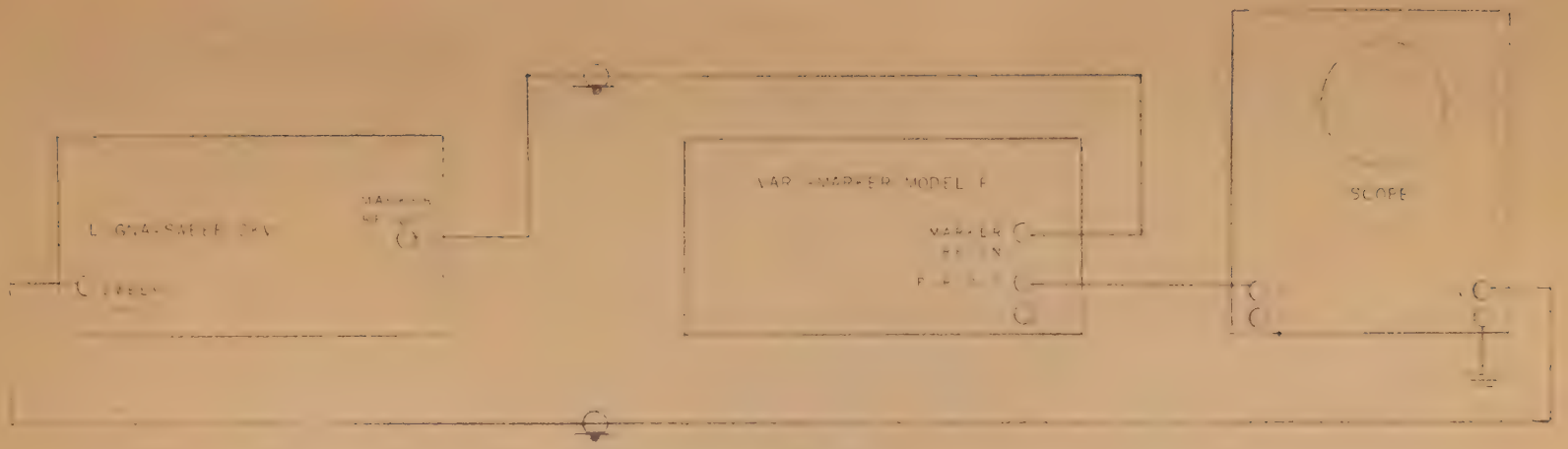


Fig. 5-1. Equipment Interconnections for Alignment Checks.

Fig. 5-2. Detector Probe

STEP 3 - CHECK BUFFER AMPLIFIER (V-2).

Set the SKV Band Selector to the 0.1 - 12 mc video band and set the MARKER SELECTOR switch on the Vari-Marker to position 5 or 6. Connect the detector probe to pin 1 of V-2 and adjust the slug in T-2 for a peak reading on the scope. Disconnect the probe.

Now connect the detector probe to the output side of T-3 and adjust the slug in T-3 for maximum amplitude of the scope trace. This frequency is around 1.445 mc. Disconnect the probe.

STEP 4 - CHECK PIP CIRCUITS (V-4, V-5, V-6).

Set the MARKER SELECTOR switch to position #2. Provide a connection between pin 2 of V-4 and the Y-input terminals on the CRO, using a 0.01uf capacitor between pin 2 and the patch cord. One sharp pulse should appear on the scope screen for each of the three marker pulses. Now connect the patch cord to pin 2 of V-5. A negative pulse should appear for each marker pulse.

STEP 5 - CHECK ADJUSTMENT OF PIP ADJ CONTROLS (R-34, R-35).

Adjust R-34 (internal) to produce stable markers over a maximum range of rotation of R-35.

STEP 6 - CHECK ADJUSTMENT OF PIP GEN ADJ (R-42).

Assuming that the connection between PIP OUT jack (J-2) and the Y-input terminals on the CRO is in place, as shown in Fig. 5-1, adjust the PIP GEN ADJ control R-42 (located on the right side of the chassis) first to produce free-running operation (picket-fence pattern) and then back off from this setting to one which produces a stable, single pulse for each marker.

STEP 7 - CHECK MARKER CRYSTAL CIRCUITS.

Resistors in series with the marker crystals (R-46, 47, 49, etc.,) or shunted across the crystals (R-48, 51, 52) are selected to provide marker pulses of proper amplitude at the input grid of V-5. Pulse amplitude should be such that proper adjustment of R-34, R-35 is accomplished at approximately mid-range Increasing the value of these resistors increases the amplitude of marker pulses at the input to the Schmitt Trigger. Capacitors C-27, C-28, etc., are used to damp vestigial oscillations. It should not be necessary to select new values.

Inductors in shunt or in series with the marker crystals are tuned to approximate resonance with the individual crystal group. Proper adjustment of variables and selection of component values in the crystal circuits will result in all marker pulses being of approximately equal amplitude at the Schmitt Trigger input. This can be checked by providing a patch-cord connection between pin 7 of V-4 and the Y-input to the scope. Advance the MARKER SELECTOR switch through positions 1 to 6 and make any necessary adjustments as discussed above.

5-3 RESHIPMENT INSTRUCTIONS.

Permission to return equipment should in every case be obtained from the factory or an accredited Kay representative BEFORE return shipment is made.

If it becomes necessary to return the Vari-Marker to the factory for repairs, it should be wrapped in protective paper and then adequately padded with soft wadding to cushion the instrument during transit. The wrapped and padded unit should be

packed in a wooden box or suitable carton.

A packing slip should be included in the carton furnishing identification of the shipper. The packing slip should also reference the instrument type and serial number. A statement pertaining to the extent of malfunction should be included to acquaint service personnel with the purpose of returning the instrument.

SECTION VI
LISTING OF REPLACEABLE PARTS

6-1 INTRODUCTION.

This section contains a listing of replaceable parts for the Vari-Marker and its power supply. All resistors are ½ watt, 10% tolerance, composition type and all capacitor values are in uuf, unless otherwise indicated.

To maintain new-instrument performance when repairs are made, use only exact replacement parts, which are obtainable from Kay Electric Company. Reference the instrument type, serial number and circuit symbol number when ordering replacement parts.

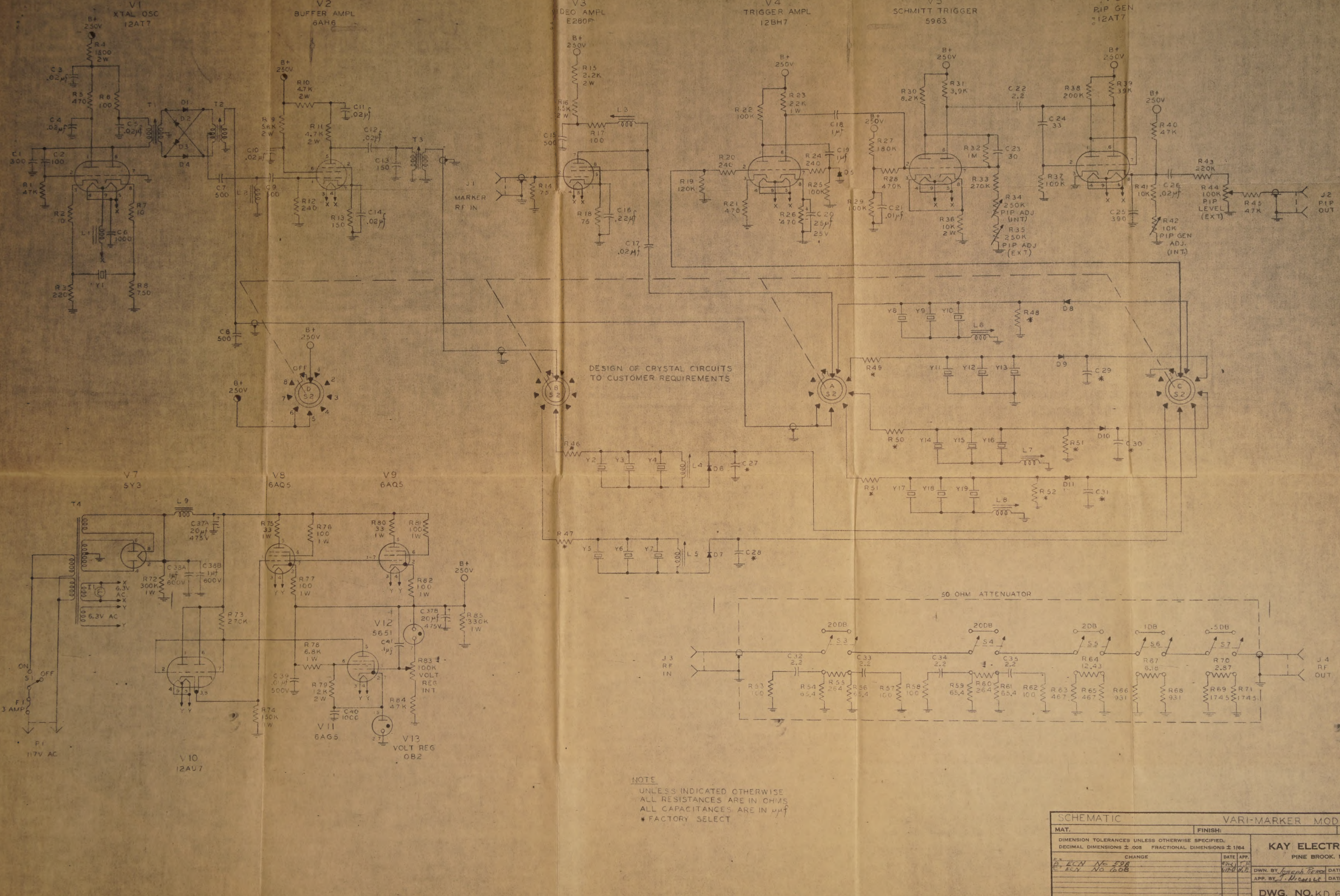
6-2 VARI-MARKER MODEL F PARTS LIST.

DWG SYMBOL NO.	DESCRIPTION	KAY PART NO.
	Capacitors: (All capacitances in uuf, 500 volts, unless otherwise indicated.)	
C-1	300, silver mica	6359-16
C-2	100, silver mica	6359-46
C-3	0.02uf, ceramic disc	6360-7
C-4	0.02uf, ceramic disc	6360-7
C-5	0.02uf, ceramic disc	6370-7
C-6	0.001uf, ceramic disc	6360-2
C-7 thru C-9	500, 300V, silver mica	6359-66
C-10 thru C-12	0.02uf, ceramic disc	6360-7
C-13	150, silver mica	6359-10
C-14	0.02uf, ceramic disc	6360-7
C-15	500, silver mica	6359-66
C-16	0.22uf, 50V, mylar	6411-1
C-17	0.02uf, ceramic disc	6360-7
C-18 & C-19	1uf, 300V, mylar	6411-9
C-20	25uf, 25V, electrolytic	6355-4
C-21	0.01uf, ceramic disc	6360-6
C-22	2.2, ceramic, tubular	6361-3
C-23	30, ceramic, tubular	6361-12
C-24	33, ceramic, tubular	6361-13
C-25	390, silver mica	6359-65
C-26	0.02uf, 400V, mylar-paper	6899-9
C-27 thru C-31	factory selected	
C-32 thru C-35	2.2, ceramic, tubular	6361-38
C-36	not used	
C-37 A & B	20/20uf, 475V, electrolytic	6355-8

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
C-38 A & B	2 x luf, 600V, bath-tub	327
C-39	0.0luf, ceramic disc	6360-6
C-40	1000, ceramic, tubular	6361-25
C-41	0.luf, 400V, mylar-paper	6899-2
D-1 thru D-4	1N126A, germanium diode	6357-19
D-5	1N126A, germanium diode	6357-19
D-6 thru D-11	G7C, silicon rectifier	6357-4
F-1	Fuse, 3 amp, 250V	245
I-1	Light indicator, Bayonet #44	249
J-1	Connector, UG-625/U	451
J-2	Connector, UG-185/U	204
J-3	Connector, UG-625/U	451
J-4	Connector, UG-185/U	204
L-1	Choke, filament, 12uh	6394-1
L-2	Choke, RF, 12uh	6394-1
L-3	Coil, special, slug-tuned	L3/6986-C
L-4 thru L-8	factory selected	
L-9	Choke, 13 hy	6338
P-1	AC line cord	328
	Resistors: (Unless otherwise specified, all components are fixed composition, ½ watt, 10% tolerance resistors.)	
R-1	47K	4731-E
R-2	10	1001-E
R-3	220	2211-E
R-4	1.5K, 2 watt	1521-H
R-5	470	4711-E
R-6	100	1011-E
R-7	10	1001-E
R-8	750, 5% tolerance	7515-E
R-9	56K, 2 watt	5631-H
R-10 & R-11	4.7K, 2 watt	4721-H
R-12	240, 5% tolerance	2415-E
R-13	150	1511-E
R-14	75, 5% tolerance	7505-E
R-15	2.2K, 2 watt	2221-H
R-16	1.5K, 2 watt	1521-H
R-17	100	1011-E
R-18	75, 5% tolerance	7505-E
R-19	120K	1241-E
R-20	240, 5% tolerance	2415-E
R-21	470	4711-E

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
R-22	100K	1041-E
R-23	22K, 1 watt	2231-G
R-24	240, 5% tolerance	2415-E
R-25	100K	1041-E
R-26	470	4711-E
R-27	180K	1841-E
R-28	470K	4741-E
R-29	100K	1041-E
R-30	8.2K	8221-E
R-31	3.9K	3921-E
R-32	1 meg	1051-E
R-33	270K	2741-E
R-34 & R-35	250K, 2 watt pot, variable	123
R-36	10K, 2 watt	1031-H
R-37	100K	1041-E
R-38	200K, 5% tolerance	2045-E
R-39	39K	3931-E
R-40	47K	4731-E
R-41	10K	1031-E
R-42	10K, 2 watt pot, variable	108
R-43	220K	2241-E
R-44	100K, 2 watt pot, variable	121
R-45	47K	4731-E
R-46 thru R-52	factory selected	
R-53	100, $\frac{1}{4}$ watt	1001-C
R-54	6514, 1% tolerance	6558-21
R-55	264, 1% tolerance	6558-37
R-56	6514, 1% tolerance	6558-21
R-57	100, $\frac{1}{2}$ watt	1011-C
R-58	100, $\frac{1}{4}$ watt	1011-C
R-59	65.4, 1% tolerance	6558-21
R-60	264, 1% tolerance	6558-37
R-61	65.4, 1% tolerance	6558-21
R-62	100, $\frac{1}{4}$ watt	1011-C
R-63	467, 1% tolerance	6558-45
R-64	12.43, 1% tolerance	6558-8
R-65	467, 1% tolerance	6558-45
R-66	931, 1% tolerance	6558-50
R-67	6.18, 1% tolerance	6558-4
R-68	931, 1% tolerance	6558-50
R-69	1745, 1% tolerance	6558-77
R-70	2.87, 1% tolerance	6558-76
R-71	1745, 1% tolerance	6558-77
R-72	330K, 1 watt	3341-G
R-73	270K	2741-E
R-74	150K, 1 watt	1541-G
R-75	33, 1 watt	3301-G

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
R-76 & R-77	100, 1 watt	1011-G
R-78	6.8K, 1 watt	6821-G
R-79	12K, 2 watt	1231-H
R-80	33, 1 watt	3301-G
R-81	100, 1 watt	1011-G
R-82	100, 1 watt	1011-G
R-83	100K, 2 watt pot, variable	121
R-84	47K	4731-E
R-85	330K, 1 watt	3341-G
S-1	Switch, toggle, SPST	255-C
S-2	Switch, rotary, 4 wafer, 9 position	7010
S-3 thru S-7	Switch, toggle, DPDT	254-T
T-1	Transformer, special	T1/6986-C
T-2	Transformer, special	T2/6986-C
T-3	Transformer, special	T3/6986-C
T-4	Transformer (power)	321
V-1	Tube, 12AT7	12AT7
V-2	" 6AH6	6AH6
V-3	" E280F	E280F
V-4	" 12BH7	12BH7
V-5	" 5963	5963
V-6	" 12AT7	12AT7
V-7	" 5Y3	5Y3
V-8	" 6AQ5	6AQ5
V-9	" 6AQ5	6AQ5
V-10	" 12AU7	12AU7
V-11	" 6AG5	6AG5
V-12	" 5651	5651
V-13	" OB2	OB2
Y-1 thru Y-19	Crystal, Quartz (Depending on customer crystal requirements)	



NOTE
UNLESS INDICATED OTHERWISE
ALL RESISTANCES ARE IN OHMS
ALL CAPACITANCES ARE IN μμf
* FACTORY SELECT

SCHEMATIC	VARI-MARKER MOD-F		
MAT.	FINISH:	SCALE:	
DIMENSION TOLERANCES UNLESS OTHERWISE SPECIFIED. DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± 1/64		KAY ELECTRIC CO. PINE BROOK, N. J.	
CHANGE	DATE / APP.		
B. ECN No. 728	9/24/61 J.H.		
C. ECN No. 608	4/11/61 J.H.		
		DWN. BY Joseph Pesce	DATE 4-11-61
		APP. BY J. Nicholls	DATE 4-11-61
		DWG. NO. KD 6986 C	

38191